

REMARKS

Claims 1-3, 5, 7, 9 and 13-20 are all the claims presently pending in the application.

To expedite prosecution, claims 5 and 17 have been amended to obviate the objection to these claims. Claims 1 and 3 also are amended merely to clarify the claimed term “oversampling rate”, and not for distinguishing the invention over the prior art. No new matter has been added.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicants specifically state that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kokuryo (U.S. Patent Publication No. 2003/0165191) in view of Adirreddy (U.S. Patent No. 6,912,250).

Claims 3, 5, 7, 9, and 13-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ushikawa (U.S. Patent No. 5,455,844) in view of Kokuryo, and further in view of Adireddy.

This rejection is respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention is directed to an equalizer and equalization method as well as a receiver and reception method which have little deterioration of the error rate

characteristic even at a low oversampling rate in order to overcome the disadvantages of symbol synchronization and demodulation processing at a high oversampling rate, which is the problem of the QAM system (e.g., see Abstract).

Conventionally, it was necessary to use a high over sample rate for an equalized process. However, the present inventors recognized that, as long as a high over sample rate is adopted to the symbol synchronization, the operation speed can be reduced.

Applicants also have recognized that those skilled in the art may consider that the equalization accuracy to the propagation properties deteriorates by reducing the sample rate.

In other words, the claimed invention is opposite to the conventional common sense (i.e., contrary to the conventional wisdom) of “the higher the sampling rate the better the results”.

However, Applicants have found that, by following quickly the variation of the propagation properties and following the properties more quickly by inserting one or more symbols and short symbol patterns at a short interval (for example, 16 symbols), the equalization accuracy to the propagation properties can be improved by reducing the sample rate. When the symbol patterns are received, it is necessary to reflect weights of the equalizer immediately and the present invention uses an algorithm having a quick response.

For example, independent claim 1 exemplarily defines an equalizer for equalizing a detection signal obtained by detecting a reception signal at an oversampling rate, the reception signal periodically including known symbol patterns made up of at least one symbol, the equalizer including symbol pattern synchronizing means for reproducing symbol timing by detecting the symbol patterns based on the reception signal at the

oversampling rate, equalizing means for acquiring an equalized signal by multiplying signals extracted from the reception signal at predetermined intervals of n samples and weights, symbol pattern generating means for generating a reference signal equal to the symbol patterns, error calculating means for acquiring an equalization error by subtracting the equalized signal from the reference signal, and weight updating means for updating the weights based on the detection signal and the equalization error at the timing of the symbol patterns detected from the reception signal of the oversampling rate.

Independent claims 3, 5, 7, and 9 define somewhat similar devices (and methods), according to the present invention.

As recited, for example, by independent claims 1 and 3, the equalizer of the claimed invention has the equalizing means which is operated at predetermined intervals of n samples, weight updating means which update a tap coefficient by the symbol timing detected from the oversampling rate and data decision means which decide data at the symbol timing detected from the oversampling rate. In other words, the processing after equalizing means (inclusive) can be operated with a low sampling rate by decimating data except for symbol timing.

Furthermore, some of the superior effects based on the low sampling rate according to the claimed invention are described on page 20, lines 1-5, page 24, lines 24-27, and page 25, lines 4-10.

II. THE PRIOR ART REJECTIONS

A. Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kokuryo in view of Adirreddy.

The Examiner alleges that the combination of Kokuryo and Adireddy disclose or suggest all of the features of the claimed invention. Applicant respectfully submits, however, that there are features of the claimed invention which are not disclosed or suggested by Kokuryo and Adireddy, either individually or in combination.

Therefore, Applicant traverses this rejection, for at least the following reasons.

Applicant notes that the primary reference, Kokuryo, does not disclose or suggest at least the equalizing means of the claimed invention, for which it is relied upon by the Examiner. Instead, the equalizer 14 of Kokuryo updates the tap coefficient using equations described in 0126-0129 and 0135-0140, "time n followed by time $(n+1)$ ".

Therefore, the equalization process of an input signal of Kokuryo is conducted using the above sample timing. Accordingly, Kokuryo does not disclose or suggest the requirement of the equalization according to the claimed invention.

In other words, Kokuryo does not disclose or suggest at least "*predetermined intervals of n samples*", as claimed, for example, in independent claim 1.

As described in the present application, symbol synchronization errors can deteriorate the error rate. Therefore, conventionally, a high oversampling rate is required (e.g., see specification at page 6, lines 3-19).

For example, in a 16 QAM, a 32 times oversampling rate is required. In contrast, in the equalization process of the present invention, a 2 times oversampling rate is permitted if a 32 times symbol synchronization is conducted. This is a novel and unobvious aspect which has been recognized by the inventors of the present invention.

Therefore, the claimed "*predetermined intervals of n samples*" is an important feature for providing the superior effects of the present invention.

Further, the ordinarily skilled artisan would recognize that, if an object is “anti-aliasing”, there would be no need to conduct an oversampling rate at a high speed of 32 times.

As recited by claims 1 and 3, the equalizer of the claimed invention has the equalizing means which is operated at predetermined intervals of n samples, weight updating means which update a tap coefficient by the symbol timing detected from the oversampling rate and data decision means which decide data at the symbol timing detected from the oversampling rate.

In other words, the processing after equalizing means (inclusive) can be operated with a low sampling rate by decimating data except for symbol timing.

Furthermore, some of the superior effects based on the low sampling rate according to the claimed invention are described on page 20, lines 1-5, page 24, lines 24-27, and page 25, lines 4-10.

In comparison, the cited references clearly do not disclose or suggest such decimation.

Indeed, Applicant submits that the present invention would not have been obvious to those of ordinary skill in the art at the time of the invention in view of Kokuryo, or for that matter, any other prior art, because the aspect of the claimed invention is opposite to the conventional common sense (i.e., contrary to the conventional wisdom) of “the higher the sampling rate the better the results”.

Moreover, Applicant submits that Adireddy does not make up for the deficiencies of Kokuryo, as described above, and indeed, is not relied upon for these features.

For the foregoing reasons, Kokuryo and Adireddy, either individually or in combination, do not disclose or suggest all of the features of the claimed invention.

Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit claims 1 and 2 to pass to immediate allowance.

B. Claims 3, 5, 7, 9, and 13-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ushikawa in view of Kokuryo, and further in view of Adireddy.

The Examiner alleges that the combination of Ushikawa, Kokuryo, and Adireddy disclose or suggest all of the features of the claimed invention. Applicant respectfully submits, however, that there are features of the claimed invention which are not disclosed or suggested by Ushikawa, Kokuryo, and Adireddy, either individually or in combination. Therefore, Applicant traverses this rejection.

For at least the reasons set forth above, Applicant submits that Kokuryo and Adireddy do not disclose or suggest all of the features of the claimed invention, for which they are relied upon.

Moreover, Applicant submits that Ushikawa does not make up for the deficiencies of Kokuryo and Adireddy, as described above, and indeed, are not relied upon for these features.

For the foregoing reasons, Ushikawa, Kokuryo, and Adireddy, either individually or in combination, do not disclose or suggest all of the features of the claimed invention. Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit claims 3, 5, 7, 9, and 13-20 to pass to immediate allowance.

III. FORMAL MATTERS

Applicants amend claims 5 and 17 to obviate the objections to these claims, in accordance with the Examiner's kind suggestions. Therefore, the Examiner is requested to reconsider and withdraw these objections.

Claims 1 and 3 also are amended merely to clarify the claimed term "*oversampling rate*", and not for distinguishing the invention over the prior art (e.g., see specification at page 10, lines 11-15; see also page 17, lines 12-16).

IV. CONCLUSION

In view of the foregoing, Applicants submit that claims 1-3, 5, 7, 9 and 13-20, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

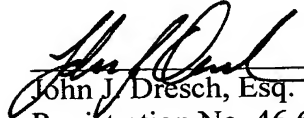
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The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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John J. Dresch, Esq.
Registration No. 46,672

Sean M. McGinn, Esq.
Registration No. 34,386

**MCGINN INTELLECTUAL PROPERTY
LAW GROUP, PLLC**
8321 Old Courthouse Road, Suite 200
Vienna, Virginia 22182-3817
(703) 761-4100
Customer No. 21254